# Fossil Flowers of *Ceratopetalum* Sm. (Family Cunoniaceae) from the Tertiary of Eastern Australia

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A fossil flower, preserved as an impression in the diatomite of the Middle Miocene Chalk Mountain Formation of the Warrumbungle Mountains, is described as *Ceratopetalum priscum* Holmes and Holmes sp. nov. The presence of petals in the fossil suggests an affinity with the extant *C. gummiferum* Sm. The flower from the Late Eocene-Early Oligocene Vegetable Creek Deep Leads of Northern New South Wales, described by Ettingshausen (1888) as *Getonites wilkinsonii*, is re-assigned to the genus *Ceratopetalum* on the basis of similarity of sepal venation to that of the extant *C. virchowii* F. Mueller. An undescribed flower from the Middle Eocene Maslin Bay flora (Christophel and Blackburn, 1978) probably represents an even earlier occurrence of *Ceratopetalum*.

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## INTRODUCTION

The genus *Ceratopetalum* Sm. includes six extant species (Hoogland, 1960, 1981) which range in size from large shrubs to tall trees. At present, the genus has a disjunct distribution in eastern Australia. The type species *C. gummiferum* Sm. is common in rainforests and sclerophyll forests on the eastern side of the Great Dividing Range in New South Wales. *C. apetalum* D. Don is restricted to rainforests in eastern New South Wales and south-eastern Queensland. The remaining four species are rainforest trees in far north-eastern Queensland. *C. succirubrum* C. T. White occurs also in New Guinea where it has a wide distribution.

The genus is characterized primarily by the enlarged and lignified sepals which radiate around the half-inferior ovary. With the exception of *C. gummiferum* which has furcate petals, all extant species are apetalous and show few differences in their floral characters.

In the past, the presence of *Ceratopetalum* in the fossil record was based on leaf impressions which bore varying degrees of similarity in gross morphology to leaves of extant species (Ettingshausen, 1883, 1886, 1888, 1894; White, 1978). Examination of the types or photographs of specimens that could be located, showed that most of the fossil leaves had a gross morphology superficially resembling *C. apetalum* or *C. gummiferum*. However, none agreed exactly with any living species. Although the flowers of extant species are, in the main, very similar, there are considerable differences in leaf morphology, so that identification of species in the field is usually based on leaf characters (R. W. Johnson, pers. comm.). Assuming that leaf form has been variable throughout the evolution of the genus, some at least of the fossil leaf species may prove to belong to *Ceratopetalum*. However, on phytogeographical grounds (Burbidge, 1960), the leaves attributed to *Ceratopetalum* from Tertiary deposits of the Northern Hemisphere (referred to in Ettingshausen, 1888) are certainly misidentifications.

Fossil pollen compared with *Ceratopetalum* has been recorded from the brown coals

of the Middle Miocene Yallourn Seam in the Gippsland Basin of Victoria (Luly *et al.*, 1980).

The fossil specimens described below are detached flowers with enlarged sepals. Their identification as *Ceratopetalum* is based essentially on the gross morphology of the 5-merous form, half-inferior ovary and particularly of the venation pattern of the sepals which bears a close similarity to that of some extant species.

## Descriptions and Relationships

Family CUNONIACEAE

Genus ***Ceratopetalum*** Sm.

*Ceratopetalum priscum* Holmes and Holmes sp. nov.

(Fig 1)

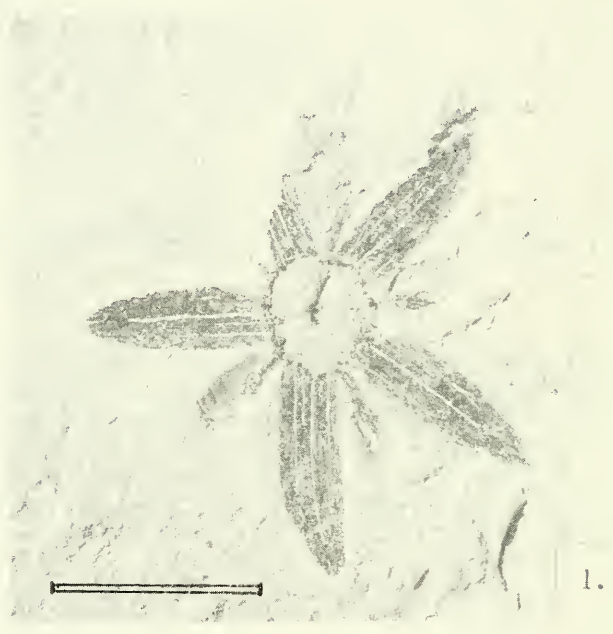

*Fig. 1. Ceratopetalum priscum* Holmes and Holmes sp. nov. Holotype MMF25501. x2.8. Scale bar equals 10 mm.

**Diagnosis:** Flower with sepals narrow-oblong, apices, obtuse, bases not contracted. Petals sometimes present but incomplete, with a single vein trifurcating distally.

**Description:** Limonite impressions or colourless moulds of dorsal and ventral surfaces of mature flowers preserved in diatomite. Ovary 3-5 mm in diameter; style 0.5 mm in diameter; no stamens preserved. Sepals 7-10 mm in length, 3-4 mm in width , narrow-oblong, not contracted at the base; apex obtuse. Sepal venation consists of three major parallel veins; a less prominent vein runs between each of the major veins and between the sepal margin and the outer veins. A few divergent secondary veins link the longitudinal veins to form a long and narrow mesh. Petals preserved only on the holotype, all with distal portion missing, 0.6-1.0 mm in width. A single vein enters the base of each petal. On the type specimen one petal expands in width as the midvein divides into three. No cuticle is preserved.

**Name derivation:** From the Latin *priscus* — belonging to former times.

**Material:** Holotype — MMF25501, Mining and Geological Museum, Sydney. From Quarry H (Griffin, 1961), Chalk Mountain Formation, Bugaldie, Warrumbungle Mountains, New South Wales. Paratypes — AMF3975 (illustrated in White, 1990, p. 197); AMF78245 and its counterpart AMF78246, Australian Museum, Sydney. From Quarry A (Griffin, 1961), Chalk Mountain Formation, Bugaldie, Warrumbungle Mountains, New South Wales.

**Geological Age:** Holmes *et al.* (1983) suggested a Middle Miocene age for the Chalk Mountain Formation. This was based on radiometric dates for volcanic rocks from other areas of the Warrumbungle Volcano Complex. The Chalk Mountain Formation is a lacustrine deposit interbedded between two basalt flows. Subsequent dating of these basalts, carried out by Dr A. Ewart in the Department of Geology and Mineralogy at the University of Queensland, has yielded and age of 17.2 million years for the underlying basalt and 13.7 million years for the overlying flow, both ages ± 2% standard deviation. The Middle Miocene age is thus confirmed.

**Discussion:** *Ceratopetalum priscum* differs from all previously described species by its uncontracted sepal bases. *C. succirubrum* has sepals which are only slightly contracted at the base but differs by its 4-merous form. The branching venation preserved in one petal on the holotype suggests that, when complete, the petals may have been trifurcate. The presence of petals indicates an affinity with *C. gummiferum* which has furcate petals. All other extant species are apetalous. The venation of the sepals is also similar to that of *C. gummiferum* (Fig. 2). A small undescribed flower from the Middle Eocene Maslin Bay flora (Christophel and Blackburn, 1978, Fig. 2c) may be a species of *Ceratopetalum*. The illustration of the flower shows no petals but appears to be closely similar to *C. priscum* in venation and shape of the sepals. Although less than half the size of *C. priscum*, it would fall within the range of size variation exhibited by flowers of extant *Ceratopetalum* spp. The flower described below as *C. wilkinsonii* comb. nov. differs from *C. priscum* by the shape and venation of the sepals.


*Fig. 2. Ceratopetalum gummiferum* Sm. Cleared sepal. x5.6.

The flora of the Chalk Mountain Formation is a mixture of rainforest and sclerophyllous elements (Holmes *et al.*, 1983). By analogy with extant species of *Ceratopetalum*, which, with the exception of *C. gummiferum*, are restricted to rainforests, it is likely that *C. priscum* was also a rainforest plant. However, it is not known at what time in the past species of *Ceratopetalum* may have adapted to non-rainforest habitats. Although *C. gummiferum* occurs in sclerophyll forests, Sanders (1983), in a study of the vegetation associated with basalt dykes near the Hawkesbury River, north of Sydney, noted that the species was more abundant in the more fertile soils derived from the dykes than in the adjacent sandy soils. This may indicate a relic preference by *C. gummiferum* for growth in an environment more favourable for rainforest vegetation.

*Ceratopetalum wilkinsonii*
(Ettingshausen) Holmes and Holmes comb. nov.
(Fig 3)

*Getonites wilkinsonii*; Ettingshausen, 1888: 167-168, fig. 12 only.

Ettingshausen's original diagnosis was based on the creation of a new genus, *Getonites*. The diagnosis of specific characters included a description of a *Getonia*-like leaf (Ettingshausen, 1888, figs. 11, 11a) but there is no basis whatsoever for this inferred association of the leaf and flower.


*Fig. 3. Ceratopetalum wilkinsonii* (Ettingshausen) Holmes and Holmes comb. nov. Holotype MMF8812. x2.8. Scale bar equals 10 mm.

**Emended Diagnosis:** *Ceretopetalum* flower, with sepals ovate-elliptical, apices obtuse. Sepal venation comparable with *C. virchowii*.

**Description:** This is based on the type and only specimen, MMF8812, which is housed in the Geological and Mining Museum, Sydney. The fossil is an impression of the ventral surface of a mature flower in a matrix of white claystone. Sepal margins and veins have been replaced by limonite. The ovary, 6.5 mm in diameter, is a structureless mass of dark material. The five sepals are ca 10 mm in length, 4 mm in width at the base, increasing to 5.5 mm at half their length and then contracting to an obtuse apex. Fig. 3 clearly shows the pattern of the venation. The incomplete reticulum may be due to the loss of vein material during preservation. Small fragments of limonite are visible between some of the sepals. Ettingshausen regarded these fragments as stamens. Perhaps they are the remains of petals.

**Geological Age:** The type locality is between Hill and Watson's shafts, Old Rose Valley Lead, near Emmaville in northern New South Wales. Based on palynological evidence and radiometric dating of overlying basalts, the age is Late Eocene — Early Oligocene (Pickett *et al.*, 1990).

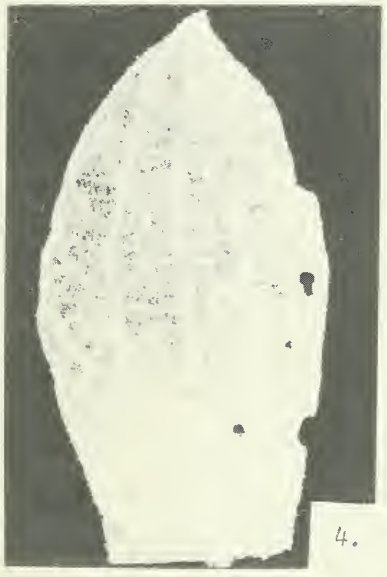


*Fig. 4. Calycopteris floribunda* (Roxb.) Lam. Cleared sepal. x11.2.

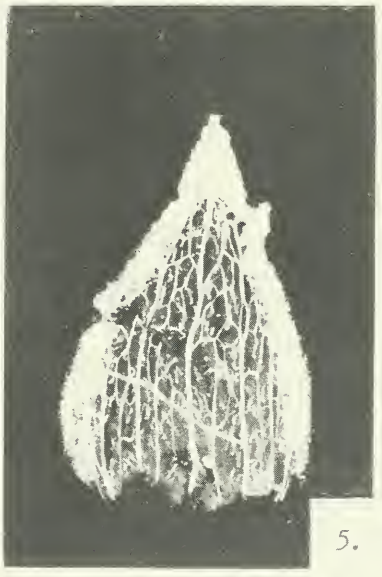


*Fig. 5. Ceratopetalum virchowii* F. Mueller. Cleared sepal. x11.2.

**Discussion:** Due to the superficial resemblance of the fossil flower to *Getonia floribunda*, Ettingshausen placed it in a new genus *Getonites* in the family Combretaceae. *Getonia floribunda* (now *Calycopteris floribunda* (Roxb) Lam.) family Combretaceae, occurs from India through south-east Asia to the Malayan Peninsula. This family is represented in Australia only north of latitude 24°S (Byrnes, 1977). Although some species in the genera *Terminalia* and *Macropteranthes* are endemic to Australia, the family is essentially of pantropic occurrence. On phytogeographic evidence (Burbidge, 1960; Johnson and Briggs, 1984) it is unlikely that representatives of the family entered Australia before the Late Tertiary. The pattern of venation on the sepals of *Calycopteris floribunda* (Fig. 4) is significantly different from the venation on the sepals of the fossil flower. However, the venation of the sepals of the fossil is closely similar to that in the sepals of the extant

*Ceratopetalum virchowii* F. Mueller (Fig. 5). On the basis of this close similarity in venation we believe the fossil is more satisfactorily placed in *Ceratopetalum*.

## Conclusion

The presence of *Ceratopetalum* flowers in the Middle Miocene and Late Eocene-Early Oligocene and *Ceratopetalum*-like flowers as early as the Middle Eocene (Christophel and Blackburn, 1978) confirms the belief of Burbidge (1960) that the genus is of ancient Australian origin.

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